Accessibility: Towards a new multimodal system performance metric
State Smart Transportation Initiative

Practical Solutions to Move America Forward
A network of reform-oriented state DOTs, founded in 2010 and housed at the University of Wisconsin.

- Executive-level Community of Practice
- Technical assistance
- Resource for the transportation community

Accessibility: Towards a new multimodal system performance metric
Today’s Speaker

Andrew Owen
Director, Accessibility Observatory
University of Minnesota

Richard Kuzmyak
Principal
Renaissance Planning Group

Kate Sylvester
Community Planner
Maryland Dept of Transportation
Access Across America
Andrew Owen – University of Minnesota
Accessibility to Jobs

- Within 40 minutes
- Free-flow speeds
- By car

Legend:

- 0 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- 5,000 - 7,500
- 7,500 - 10,000
- 10,000 - 25,000
- 25,000 - 50,000
- 50,000 - 75,000
- 75,000 - 100,000
- 100,000 - 250,000
- 250,000 - 500,000
- 500,000 - 750,000
- 750,000 - 1,000,000
- 1,000,000 +

Interstate highways
US highways
What is Accessibility?
What’s the purpose of a transportation system?
Accessibility is about opportunities
Mobility

- Mobility measures *ease of movement*
- What’s the difference?
MnDOT Motivations

- Looking beyond mobility and congestion
- Supporting our vision for transportation outcomes
- Developing a multimodal approach to planning and performance
Building on Local Expertise

- Access to Destinations project
- Established theoretical and technical foundations
- Accessibility evaluation system for Twin Cities
Building on Local Expertise

- Access to Destinations project (http://access.umn.edu/publications/destinations/reports/)
  3. Travel Time Estimation on Arterials (2007)
  8. Computation of Travel Time Data for Access to Destinations Study (2008)
 10. Arterial Data Acquisition and Network-Wide Travel Times Estimation (2010)
 12. Using Twin Cities Destinations and Their Accessibility as a Multimodal Planning Tool (2012)
Jobs accessible within 20 minutes by car (AM peak) 2010

Zone Structure Displayed: Traffic Analysis Zone Boundaries
Primary Data Sources: MnDOT, Twin Cities Metropolitan Council, US Census Bureau

NEXUS Research Group
Jobs accessible within 20 minutes by transit (AM peak) 2010

Zone Structure Displayed: Traffic Analysis Zone Boundaries
Primary Data Sources: MnDOT, Twin Cities Metropolitan Council, US Census Bureau
Accessibility in the Media

“Focusing on accessibility ... will get us much closer to tackling the frustrations that plague commuters.”
— National Review
Accessibility in the Media

“Transportation is not an end in itself; it’s a means to other ends ... If the purpose of an urban transportation system is accessibility, we should work to make the system serve that goal”

— Reason Foundation
Accessibility Is Not a New Idea

Cumulative Opportunities

- Simple count of destinations reachable within threshold.
- It is not an index, it is an actual thing.
- “30-minute accessibility to 10,000 jobs”
- “Can reach 10,000 jobs within 30 minutes”
- Multiple metrics and maps for multiple thresholds
Expanding the scope, increasing the resolution
Accessibility to Jobs

- Within 40 minutes
- Free-flow speeds
- By car
Minneapolis
Minneapolis-St. Paul-Bloomington, MN-WI

Jobs within 30 minutes by transit, averaged 7 - 9 AM

- 0 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- 5,000 - 7,500
- 7,500 - 10,000
- 10,000 - 25,000
- 25,000 - 50,000
- 50,000 - 75,000
- 75,000 - 100,000
- 100,000 - 250,000
- 250,000 - 500,000
- 500,000 - 750,000
- 750,000 - 1,000,000
- 1,000,000 +
Accessibility is About the Big Picture

- Evaluation
- Monitoring
- Planning
Worker Weighted 20-minute Accessibility to Jobs by Auto

- Washington: 166,932
- Scott: 100,202
- Ramsey: 628,888
- Hennepin: 717,532
- Dakota: 256,635
- Carver: 111,667
- Anoka: 228,051
Change in Accessibility to Jobs
- 2010–2013
- Within 30 minutes
- Averaged 7–9 AM

Legend:
- < -100%
- -90 to -100%
- -80 to -90%
- -70 to -80%
- -60 to -70%
- -50 to -60%
- -40 to -50%
- -30 to -40%
- -20 to -30%
- -10 to -20%
- 0 to -10%
- 0 to +10%
- +10 to +20%
- +20 to +30%
- +30 to +40%
- +40 to +50%
- +50 to +60%
- +60 to +70%
- +70 to +80%
- +80 to +90%
- > +90%
- > +100%

- Transit Routes
- Highways
Change in Accessibility to Jobs

- "No 6" Scenario
- Within 30 minutes
- Averaged 7–9 AM

Legend:
- < -100%
- -90 - -100%
- -80 - -90%
- -70 - -80%
- -60 - -70%
- -50 - -60%
- -40 - -50%
- -30 - -40%
- -20 - -30%
- -10 - -20%
- 0 - 0%
- 0 - +10%
- +10 - +20%
- +20 - +30%
- +30 - +40%
- +40 - +50%
- +50 - +60%
- +60 - +70%
- +70 - +80%
- +80 - +90%
- +90 - +100%
- > +100%

- Transit Routes
- Highways
Consistent Methodology Allows Meaningful Comparisons

From Access Across America: Transit 2014
(http://access.umn.edu/research/america/transit2014/index.html)
Access Across America
Pooled Fund

• Led by Minnesota Department of Transportation
• Annual reports: Access Across America
• Partner benefits:
  • Sponsorship of annual report
  • Detailed data and report for local state/metro
  • Input into methodology and data decisions
• More information: http://access.umn.edu/research/pooledfund/
Thanks!

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Advancing the Role of Accessibility in Planning and Decision Making

SSTI Webinar
December 3, 2014
Why the Interest in Accessibility?

- MAP-21: Raised bar for performance-based planning & programming
- Perhaps the most essential measure of transportation performance – “opportunity provided”
- Reflects the synergy between the built environment (land use) and transportation system
- Applied across modes, quantifies the number and quality of travel choices
What Doors Does It Open?

- **Enhanced analytic capability:** GIS data and tools provide a new platform and math to get at strategic relationships (land use, non-motorized travel, transit)

- **Sharpens decision-making:**
  - Measures are intuitive, often visually compelling
  - Puts modes on more equal footing: shifts focus to moving people & goods *rather than* “solving” congestion
  - Encourages greater coordination between land use and transportation decisions

- **Inclusive:** Opens the planning process to a wider range of stakeholders
Using Accessibility for Planning

• NCHRP 8-78/Report 770: *Estimating Bicycling and Walking for Planning and Project Development*

• Maryland Department of Transportation: *Multimodal Accessibility Pilot Corridor Study*

• City of Asheville, NC: *East of the Riverway Transportation Network Plan*

• Montgomery County MD DOT: *White Flint TDM CIP study*

• Florida DOT District 1: *Central Manatee Co. Network Alternatives Analysis*
NCHRP 8-78/Report 770

• Purpose: Address gap in methods to estimate bike/walk demand (existing models too coarse)

• Key unanswered concerns:
  – Role of land use
  – Role of facilities
  – Impact on motorized travel

• Result: Report 770 practitioner guidebook

• Key Product: Arlington GIS Accessibility Model
A Simple but Powerful Framework

ACCESSIBILITY =

Land Use

Transportation Network

Opportunities
- Number
- Variety
- Proximity

Travel Time
- Connectivity
- Directness
- Safety

NCHRP Report 770
Arlington GIS Accessibility Model

Use GIS to create relationships through layering

- "Transportation Connections"
- "Land Use"
- InfoUSA Employment Data
- NAVTEQ All Streets Network
Calculating Accessibility Scores

Accessibility = \sum \frac{Opportunities}{Travel Time * Decay}

Where:

**Opportunities** = Number of Jobs (HBW) or Number of Retail/Service Establishments (HBNW)

**Travel Time** = Time to reach opportunity over *actual network* (Network Analyst)

**Decay** = Factor reflecting decrease in value of opportunity that are farther away
Distance-Decay Relationships
(derived from travel survey trip distributions)

Calculated for all modes and travel purposes
Scores Calculated for Each Mode

Modal Activity Ranges

Starting Point

Travel Time Decay Curve

Accessibility Score = Σ time-decayed opportunities
Comparing Accessibility Scores for Different Settings
## Accessibility’s Influence on Mode Choice

### Comparative Accessibilities

<table>
<thead>
<tr>
<th>Mode</th>
<th>Logan Circle</th>
<th>Clarendon</th>
<th>McLean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>4.26</td>
<td>2.25</td>
<td>1.0</td>
</tr>
<tr>
<td>Transit</td>
<td>13.6</td>
<td>4.82</td>
<td>1.0</td>
</tr>
<tr>
<td>Bike</td>
<td>15.17</td>
<td>3.71</td>
<td>1.0</td>
</tr>
<tr>
<td>Walk</td>
<td>38.9</td>
<td>6.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### Non-Motorized Mode Share (HH survey)

<table>
<thead>
<tr>
<th>Location</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logan Circle</td>
<td>41%</td>
</tr>
<tr>
<td>Clarendon</td>
<td>21%</td>
</tr>
<tr>
<td>McLean</td>
<td>8%</td>
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</tbody>
</table>
Statistically Linking Accessibility Scores with Mode Choice Patterns in Travel Survey

Mode Choice in Relation to Walk Score (HBW, Origin)

Mode Choice in Relation to Walk Score (HBNW, Origin)

Mode Choice in Relation to Walk Score (HBW, Destination)

Mode Choice in Relation to Walk Score (HBNW, Destination)
Using Model to Estimate Walk Trip Flows (WALC model available in NCHRP Report 770)
Identifying Unmet Walk Opportunities

Major Attractions

“No-Man’s” Land

Major Productions
• Existing tools lack sensitivity for complex planning and programming needs
• Review options to supplement or substitute
• See potential in NCHRP 8-78 Accessibility Model
• Recommend pilot study of multimodal accessibility (MMA) approach in major corridor
MD 355/I-270 Pilot Study Corridor

- 26 miles
- I-270 changed MD 355 to “Main Street”
- Metrorail & MARC, BRT under study
- Multimodal (but still very auto-oriented)
- High growth – issue of sustainability
- Multiple jurisdictions with planning authority
Auto Accessibilities: Work & Non-Work (TAZ)
Transit Accessibilities: Work & Non-Work (TAZ)

Analysis Preview - MD355 & I270 Corridor - Existing Conditions

MDA TAZs
IMMA Transit HW
0 - 19,996
19,997 - 22,226
22,226 - 30,347
30,347 - 63,830
63,831 - 91,929
91,929 - 101,292
101,292 - 173,016
173,016 - 191,510
191,510 - 194,540
194,540 - 274,950
274,950 - 392,840

(synthetic breaks)
Walk Accessibilities: Work & Non-Work (Block)
Decay Factor Applied to TAZ Transit Accessibility Score

<table>
<thead>
<tr>
<th>Transit Walk Access Time</th>
<th>Work Travel</th>
<th>Non-Work Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
<td>0.998</td>
<td>0.998</td>
</tr>
<tr>
<td>5 min</td>
<td>0.704</td>
<td>0.702</td>
</tr>
<tr>
<td>10 min</td>
<td>0.496</td>
<td>0.452</td>
</tr>
<tr>
<td>15 min</td>
<td>0.349</td>
<td>0.291</td>
</tr>
<tr>
<td>20 min</td>
<td>0.247</td>
<td>0.188</td>
</tr>
</tbody>
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SSTI Webinar (Dec. 2014)
New Equations to Estimate Mode Split from Auto, Transit & Walk Scores (HBW)

**Mode Choice at Origin**
- Auto % = $0.826 + (1.38E-07) \text{MMA-A} - (1.45E-06) \text{MMA-T} - (6.71E-07) \text{MMA-W}$
- Transit% = $0.052 - (1.23E-07) \text{MMA-A} + (1.41E-06) \text{MMA-T} + (9.48E-06) \text{MMA-W}$
- Walk% = $0.003 + (2.98E-07) \text{MMA-T} + (1.89E-06) \text{MMA-W}$

**Mode Choice at Destination**
- Auto % = $0.984 + (4.54E-08) \text{MMA-A} - (8.45E-07) \text{MMA-T} - (5.77E-06) \text{MMA-W}$
- Transit% = $0.022 - (8.63E-08) \text{MMA-A} + (7.88E-07) \text{MMA-T} + (4.75E-06) \text{MMA-W}$
- Walk% = $0.003 + (1.20E-07) \text{MMA-T} + (1.15E-06) \text{MMA-W}$

**Where:**
- MMA-A = Multimodal Accessibility Score for Auto
- MMA-T = Multimodal Accessibility Score for Transit
- MMA-W = Multimodal Accessibility Score for Walk
Predicting Mode Shares at Block Level

Transit Accessibility: HBW

Transit Mode Share: HBW
Predicting Mode Shares at Block Level

Auto HBW

Walk HBW
Using MMA Score Categories & Combinations to Profile Place Types

<table>
<thead>
<tr>
<th>Transit</th>
<th>Tier</th>
<th>MMA Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>&lt;67k</td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>67k - 102k</td>
</tr>
<tr>
<td></td>
<td>T3</td>
<td>103k - 151k</td>
</tr>
<tr>
<td></td>
<td>T4</td>
<td>152k - 228k</td>
</tr>
<tr>
<td></td>
<td>T5</td>
<td>&gt; 228k</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Walk</th>
<th>Tier</th>
<th>MMA Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
<td>&lt;329</td>
</tr>
<tr>
<td></td>
<td>W2</td>
<td>329 - 1513</td>
</tr>
<tr>
<td></td>
<td>W3</td>
<td>1514 - 3577</td>
</tr>
<tr>
<td></td>
<td>W4</td>
<td>3578 - 7607</td>
</tr>
<tr>
<td></td>
<td>W5</td>
<td>&gt;7607</td>
</tr>
</tbody>
</table>

89% A, 10% T, <1% W
72% A, 25% T, 3% W
64% A, 30% T, 6% W
46% A, 45% T, 9% W
1. Accessibility should (and will) be a primary measure in transportation planning and decision-making

2. Measures and maps communicate information simply and effectively – encouraging participation

3. GIS is much more than maps: a strategic platform – and math - for creating key relationships

4. Accessibility framework (land use/networks) encourages synergistic land use and transportation planning

5. These new tools can be stand-alone scenario planning tools or to supplement state/MPO TAZ models
THANK YOU!

A recording of this webinar will be on the SSTI web site tomorrow.

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